A Rechargeable Lithium Battery with Li_2O_2 Cathode in Closed Systems

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Li-O_2 batteries have one of the highest theoretical specific energy of 3,458 Wh/kg when the weight of the primary discharge product, *i.e.*, Li_2O_2, is considered. Thus, this BIL (Beyond Lithium Ion) battery technology, if made practical, will find extensive usage especially in the successful electrification of vehicles. However, there are many challenges. Current Li-O_2 batteries demonstrated in labs have been limited to "open systems", *i.e.*, batteries that have a porous carbon cathode that "breathes" pure oxygen. The limitations of these systems are the requirement of pure oxygen. In addition, the consensus among researchers on specific capacity (mAh/g) calculations based on active materials is lacking because extra oxygen is continuously supplied to cells upon cycling. One solution to these limitations is the use of closed systems, *i.e.*, storage and reuse of O_2 within the cell. Recently, our group has demonstrated a closed and rechargeable lithium battery with Li_2O_2 cathode for the first time. This platform is unique as it shows, for the first time in literature, capacites and rate capability based on mass of Li_2O_2. The cell shows a close-to-theoretical capacity over 18 cycles and shows 50 cycles when the charge capacity is limited to 50% of theoretical. It allows other studies on the stability of electrolyte, electrode kinetics, and oxygen storage materials. This system can eleminate the issues of open systems such as impurities oxygen gas and evaporation of electrolyte. Unstable electrolytes are a major bottleneck in Li-O_2 batteries. Such a system provides a suitable medium to optimize electrolytes and other cell components.